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KNOWLEDGE AND POSSIBILITIES OF GRAVITY RESEARCH

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INTRODUCTION

The nature of gravity and the nature of time are the last concepts which have not yet been sufficiently explored. Numerous physicists have devoted years of study to the exploration of the nature and origin of gravity. I. Newton has discovered the law of gravitation in 1687, and no exception to this law has yet been found. A. Einstein has somewhat clarified the nature of gravity and has established that gravity and inertia cannot be separated. One has believed at one time that electrical methods could be used to solve gravity problems, but without success. Also, heat did not offer any solution. The gravitational field cannot be shielded. Table 1 offers ten of the most common suggestions; five of them contradict laws of nature; two others are practically impossible; and two are at present under study.

Recently, great hopes were set on nuclear physics. Not only physicists but also many scientists believe they have come close to the solution of gravity.

Interest in gravitation research has increased especially in the past few years. Unfortunately, this has led to the use of concepts and terminology which frequently are senseless. In most cases, these concepts contradict natural laws which have full validity. Incredible claims have come from laymen, that metals already exist which are free from gravity or at least lessen gravity. This is

Table 1. Previously Proposed Possibilities of Floating

A. By Cancelling Gravity (Passivating Methods)

Separation of Gravity and Mass	Decreasing Gravity	Neutralisation by Gravitation Repulsion	Shielding of the Gravitational Field	Gravitation-free (abaric) Field by Mass Compensation
"Weightless Mass" by removing the gravitational component.	"Gravithermal" heat or mechanical strain is claimed to reduce gravity (phlogiston theory).	Polarity theory of gravitation. Charge with "negative" gravitation as compensation.	Absorption or reflection of gravitational fields by specific substances.	Arrangement of an antimass to compensate for an existing gravitational field.

B. By Action against Gravity Acceleration (Activating Methods)

Repellant Gravitational Field	Compensation of Gravitational Waves	Repellant Electrical or Magnetic Fields	Mechanical Impulses	Space Changes
"Negative Mass" —"Antimass", mass with property of gravitational repulsion.	Direct compensation by conversion of electrical or nuclear energy.	Action of electromagnetic forcefields against the direction of gravity.	Either thrust of expelled masses (e.g. rocket) or lift of external flowing force (wings).	"Creation" and "Destruction" of mass by peristaltic expansion and contraction of space.

supposed to be accomplished "by special processing", although it is still "secret". In fact, it was so secret that these substances or processes did not exist at all and could not possibly exist.

It is, therefore, proper to clarify this field from the point of view of the engineer in order to determine what is known and what possibilities one can expect in the future. If these prospects appear too fantastic, we may say that the following explanations do not transgress beyond the boundaries of modern physics.

MASS AND GRAVITY

1. The non-validity of natural laws can be proved only by an unobjectionable proof of exceptions and contradictions. There is not the slightest reason to doubt that mass is inseparably related to gravity.

Entirely absurd is the assumption of an "anti-mass" without gravity or even with gravity repulsion. Such a substance would violate the law of the conservation of energy. Moreover, it could not possibly exist in our universe.

A favorite speculation of the present time is the assumption that certain "inverted" atomic structures could result in abnormal gravitational properties. Apart from the fact that these atomic structures cannot produce stable substances, there is no reason to assume that an "atomium" (=electron nucleus about which positions revolve) or a mesonic atom (mesonium, anti-mesonium = nucleus about which μ-mesons instead of electrons revolve) should behave gravitationally different than an ordinary atom.

All previously discovered elementary particles are subject to gravitation just like any mass. This applies, for example, also to the photon with rest mass zero.

2. Cosmologically, the universal existence of gravitational attraction has been demonstrated without exception. There is no gravitational repulsion between masses. This absence of polarity in gravitational fields has led to the assumption that the steady expansion of our universe is connected in some way with gravitation. The constant increase in space in our universe has been proved by a shift in the red spectrum of distant stars.

F. Hoyle who has expressed this belief (ref.1), also claims that the expansion of space must simultaneously result in the creation of new mass, and that this is the cause of the universal gravitation constant (first determined by Cavendish in 1778).

P. Jordan has brought proof of the correctness of Dirac's theory (ref. 3) . The latter assumes that the gravitation constant has changed in the course of time.

3. As we have mentioned, all previously discovered elementary particles are subject to the laws of gravity, fully and to the same extent, regardless of their origin. No exception or modification has been proved, in spite of many claims that the discovery of the so-called gravitons is near. This non-exception holds true also for particles of wave mechanics whose mass has been obtained merely by velocity of propagation, for example photons.

It is, therefore, not clear why perhaps the neutrino should be an exception, as this has recently been claimed. At least, there are no proofs for such an exception.

According to the state of our present knowledge, it is hopeless to expect the discovery of any elementary particles which are free from inertia or are not subject to gravitational laws. Mass and gravity cannot be separated any more than inertial mass from gravity mass. Mass without gravity is unthinkable.

4. J. Mandelker has advanced a theory (ref. 4) according to which the velocity of light is supposed to change within gravitational fields. This would mean that gravity fields and gravity waves are subject to the laws of quantum physics. This is at present assumed more and more by theoretical physics.

5. Before we turn to the concept of gravitational force itself, we must first answer the question "what is mass"?

A. Einstein always has upheld the belief that mass is the result of a concerted action of electro-magnetic fields and gravitational fields. This is in good agreement with the knowledge that gravity and mass cannot be separated, and that the attraction between masses is proportional to the size of the masses. There is no physical observation which contradicts this hypothesis of Einstein.

6. The study of the nature of gravitation is hindered by the circumstance that gravitation fields are extremely weak in comparison with other elementary force fields.

This disproportion leads to two important conclusions:

a. It explains why we know so little about the nature of gravitation. Modifications or changes always are of such a small order of magnitude that they either cannot be detected or are immeasurably small. This means, that irregularities or influences of gravity fields may exist, but that their manifestations are too weak to be detected or measured.

b. Neutralization or reversal of gravity effects (perhaps for the purpose of levitation or motion against gravity acceleration) would essentially require only a minimal fraction of the elementary energy which is at present available (e.g. from nuclear conversions).

From physical standpoint, all present methods of levitation or upward motion are extremely uneconomical or ineffective, since all these impulse-reaction

methods work only indirectly and in roundabout ways with high losses of thermodynamic conversions. The question arises now whether no direct way is possible.

7. To follow up this thought, we can gain some important conclusions from the results of A. Einstein's unified-field theory.

V. Hlavaty (ref. 5), who derived conclusions from Einstein's general statements, claims that the density of the rest-mass and the gravitational fields are of electromagnetic nature. The electromagnetic field is elementary and primary, and a gravitational field connot exist at all without it. Both types of fields are related, and one may be expressed by the other. However, gravitation cannot cause the formation of a sort of electromagnetic fields, but only of plane light waves.

8. If we assume these important results of the relativity theory as valid, it necessarily follows that the entire (or at least partial) gravitational energy during conversion of mass into energy must be manifested as radiation. It is uncertain which form such a gravity radiation must assume. They may be gravity waves or gravitons, but they may also be an additional ordinary electromagnetic radiation.

9. The existence of gravity corpusoles (gravitons), analogous to photons of light, necessarily follows from wave mechanics for the case that gravity fields are subject to the laws of the quantum theory, However, since this has not yet been proved, the existence of gravitons still remains hypothetical.

Of course, it is not clear why gravitational fields should not posses the dualistic character of wave mechanics. Therefore, theoretical physicists tend to believe that gravitons are associated with gravity waves. Scientists like H. Bondi, I. Robinson, F.A.E. Pirani and others have proved that gravitation waves are capable of energy transfer (ref. 6).

However, it is improbable that gravitons will be discovered soon. The occasional claim that these hypothetical corpuscles are equivalent to neutrin certainly is erroneous; at least, no physical proof exists.

10. Einstein's field theory refers only to the macroscopic world. The theory does not include the quantum theory of wave fields. Also, it disregards fields of nonelectrical nature, as have been observed in atomic nuclei.

Theoretical scientists have tried for years to find a generally valid theory by expanding Einstein's statements. These investigations are mathematically extremely involved. Their results are needed if one wants to obtain further knowledge on the nature of gravity from the relativistic field theories.

11. Studies in this direction are being carried out by B.S. DeWitt (ref. 7), Heisenberg and Pauli and H.E. Salzer (ref. 8), H.J. Kaeppeler and B. Heim (ref. 9), St. Dereser and R. Arnowitt (ref. 10) and V. Hlávatý. However, all these expansions or modifications of A. Einstein's four-dimensional unified-field theory irrefutably lead to field theories with six and more (up to ten) dimensions. It is hereby of no concern from which viewpoint the theoretical scientists start in their statements of the problem.

For example, H.E. Salzer starts from purely mechanical considerations. B. Heim uses a general basis without prerequisites to comprise all events mathematically. H.J. Kaeppeler starts from the knowledge of nuclear physics, and St. Dreser and R. Arnowitt coordinate the quantum theory in Einstein's theory.

However, each higher dimension of the determining general field-equations made it more difficult to obtain solutions which permit a physical interpretation. For this reason, there was almost no hope of obtaining general conclusions.

AN "INTERMEDIATE FIELD"

12. Nevertheless, all these multidimensional and generally valid field theories admit the conclusion that a field must exist which lies halfway between gravitational field and electromagnetic field. Let us designate it briefly as "intermediate field". This field is, therefore, neither electromagnetic nor gravitational; it lies between these two types of field but differs from them.

13. Such an intermediate field is macrocosmically unknown. This also explains why Einstein's theory does not prove the existence of such a field. The relativity theory states only that gravitational fields in some way also possess electromagnetic nature. However, this theory does not explain how this relationship exists and how a conversion can take place.

Relativity scientists like V. Hlávatý who have studied further problems of the unified-field theory, admit the possibility of an intermediate field (ref. 11).

14. One might now conclude that the intermediate field lies in the confines of the atomic nucleus. However, this field would have to be of such a nature that is does not measurably appear outside of these narrow confines.

15. Let us now study the results of the work with multidimensional field theories.

H.E. Salser assumes relativity for uniform accelerations and with alternating gravitational fields. From this he derives intermediate relations which are believed to exist in a special dynamic effect field.

16. B. Heim claims (as the only one in the world) that he can prove the existence of his "meson-field" by direct experiment with available arrangements. He is so certain of this that he is waiting to disclose his mathematical theory only after he has completed his proof.

If one considers that proofs for the validity of Einstein s relativity theory until now have been limited to three (still disputed) astronomical observations (ref. 12), and that one hopes to find better proofs or suitable experimental possibilities only in the future, it is surprising why B. Heim has not been able to obtain funds to prove his far-reaching theories.

During the first world war (1918), England financed an exploratory expedition to Australia to obtain proof of Einstein's relativity theory by light deflection during an eclipse of the sun.

17. It appears to be in complete agreement with the theories of other theoretical relativity scientists that, according to B. Heim, the intermediate field makes it possible to oppose gravity acceleration immediately, that is, at its sources, by using energy bound in the mass. The latter is important, because otherwise the compensation of gravitation would contradict laws of nature. Such a conversion in the intermediate field would have to be almost without loss, according to B. Heim, so that the necessary energy expenditure would be negligibly small.

B. Heim further claims that another "state" of the intermediate field makes it possible to convert mass directly into electromagnetic energy. This is possible also almost without loss by heat or secondary products. Also the direct conversion of electromagnetic energy into mechanical energy is possible, and B. Heim claims to be in the position to prove this by experiments.

18. It is hardly necessary to emphasize the technical consequences which may result from such a theory, if it should prove to be correct. It should be mentioned in this respect that it is in agreement with all valid laws of nature to compensate the gravity acceleration by direct expenditure of elementary energy. We deal, therefore, not with a "liberation of gravity", which would correspond to

a perpetuum mobile. None of B. Heim's conclusions violates one of our known laws of nature, as fantastic as these conclusions may seem.

"PRIMARY MATTER" AND GRAVITY

19. One may now ask whether the intermediate field predicted by theory actually exists in nature. It is obvious to search for it in the field of nuclear physics.

The nature of the nuclear binding forces has demanded special attention for a long time. We deal here with effective force fields which are neither of electrical, nor of magnetic, nor of gravitational nature. They are limited to very short ranges and are the basis for the existence of atomic nuclei, that is, they are, so-to-speak, the cement which holds neutrons and protons together. These force fields are elementary and universal. Their strength may be seen from the fact that they are capable of overcoming the repulsion between protons, and that their range is limited to the minute dimensions within the nuclei. This makes them difficultly accessible to experimental study.

20. In order to explain these extremely strong fields of force within the nucleus, atomic physics has advanced theories of meson fields. According to H. Yukawa (ref. 13), each nuclear particle is surrounded by a meson field, which is believed to maintain the nonelectrical cohesion with other nuclear particles. Mesons are believed to be the carriers of energy quanta in these fields. Therefore, they correspond to the protons of the electrical nuclear field.

In the meantime, free mesons have been experimentally demonstrated, and seven types have been discovered. The lightest mesons have 210 time the rest-mass of the electron. Their life period is very short. The Pi-meson of the nuclear bond has 276 times the rest-mass with a life period of several 10^{-8} seconds.

21. H. Born already has pointed out that the meson fields of Yukawa's theory might have some connection with the nature of gravitation. Eddington and Schroedinger arrived at a similar hypothesis (ref. 14). Pauli and Blackett assume that the life period of mesons is inversely proportional to the square root of the gravitation constant (ref. 15).

22. The intermediate field of multidimensional field theories mentioned in section 12 is different from electromagnetic fields. Not counting gravitational fields, the only known type of non-electrical field is that of nuclear bond fields, that is, they act unimpeded through matter.

23. This suggests a comparison of nuclear bond fields with the intermediate field, which is presupposed by theory.

24. This gives us a picture of three elementary types of fields in the universe which alone are responsible for the existence of mass and energy:

Electromagnetic fields
Intermediate fields of nuclear binding forces
Gravitational fields

Gravitational fields are the weakest, and nuclear binding fields the strongest fields. The latter are limited to ranges of several Fermis (1 Fermi = 10^{-13}cm.), and the two other fields have unlimited effective range. Gravitational fields can neither be weakened nor shielded, and this is true for electrical and magnetic fields. Moreover, the gravitational field always is nonpolar between masses.

25. Such a field assumption may aid to a better understanding of the relations between mass, energy and gravity.

Recent developments in atomic physics lead to the assumpsion of a "primary mass" (ref. 16). This is believed to be the primary substance of which all particles of mass consist. Of course, one must consider that there is a rest-mass

as well as a mass acquired by motion. Both types of mass are subject to gravitation to the same extent.

26. How could such a "primary matter" be imagined?

It cannot be mass nor dynamic energy. Therefore, it could only be latent energy, just as in a resting waveless gravitational field between immobile masses. This energy would extend all through the universe and, therefore, would be an "ether" of latent energy and of an all-penetrating nature.

27. However, the impossibility of the existence of a resting universal ether has long been proved. A.A. Michelson and E.W. Morley's classical experiment of 1887 on the relative propagation of light has made such a hypothesis improbable. The only question is in how far the result of Michelson-Morley's experiment is applicable to the supposed primary matter.

The intermediate field of the nuclear binding forces is limited to minute ranges which are much smaller than wavelengths. If we imagine the primary-matter ether as the sum of infinitely many and infinitely small "fields", each having the effective range of the nuclear binding forces, it could not be affected at all by light waves. One may then say that the result of Michelson-Morley's experiment is not conclusive, in this case. The primary-matter ether has nothing in common with propagation of light.

28. One might attribute the following properties to the ether-like primary matter: Since it does not radiate, it cannot be detected by present-day means. Also, it is not subjected to quantum laws. This may be concluded from the observation that the laws of quantum-electrodynamic are no longer valid in the range of Fermi distances (ref. 17). This also satisfies Heisenberg's formula of the elementary particles. A further consideration indicates that one can attribute a gravitational character to this primary matter, with the important

difference that gravitational repulsion exists between the individual small "fields". Of course, this supposition needs proving.

30. The lack of polarity in gravitation has always been an enigma. All other natural forces have the property of repulsion as well as attraction. It must, therefore, be expected that, in the end, also gravitation has polar character. As we know, this is not the case between masses. The opposite polarity must, therefore, exist in some other way.

If we imagine the "primary matter" as an ether which fills the universe, and simultaneously consider that the universe is constantly expanding, and that this expansion has been related to the gravitation constant by cosmologists, it is logical to attribute to the ether the tendency of expanding in the manner of gas. The driving force may be gravitational repulsion between the individual force fields. An additional reason for this assumption will be given in section 33. This may be brought to agreement with Dirac's theory of the existence of absolute negative energy in a vacant space.

Consequently, the primary-matter ether would also be responsible for the creation of new mass as a result of the expansion of the universe.

MASS AND ITS PROPERTIES

31. As we have stated in section 8, any conversion of mass to energy must be accompanied by a release of gravitational energy in some form. The fact that such a liberation of gravitational energy has never been observed and that, therefore, we do not know in which form free gravitational energy appears, may be explained by the small fraction of the total energy which the gravitational energy comprises.

Experimentally, this situation may be considered as a practical impossibility of proving mass differences in chemical conversions by heat changes. In exothermal processes, mass energy is converted to heat, but the weight changes are so small that they cannot be detected with present-day measuring devices.

32. If the gravitational energy is liberated in the radiation of mass, which is seriously doubted, free gravitational energy must logically be introduced during the formation of mass.

33. Let us consider how the equivalent moving mass ($=E/c^2$), that is, increase in mass by motion, could be created. For this purpose, we shall use the theory of a primary-matter ether discussed in sections 26 and following. One could imagine that the rapid passage of an ether of minute fields of latent gravitational energy produces an increase in mass, that is, increase in gravity and inertia, as long as the motion persists. Therefore, the latent primary-matter energy must itself be gravitational energy in some form or at least must liberate such an energy. This makes a connection between primary matter and latent or free gravitational energy probable.

34. Also another daily phenomenon of mechanics may now be explained. When masses are accelerated, they appear to show inertia. According to Einstein, it is impossible to distinguish between inertial mass (equivalent principle of the general relativity). One may also say that the gravity of an accelerated mass during the acceleration is increased in proportion to its magnitude. This identity is conceivable, if one considers the effect of the resting primary-matter ether in comparison with the accelerated mass. An addition of free gravitational energy may, therefore, well be the cause of inertia.

35. Mass could be imagined as the result of the effect of electromagnetic fields on the primary-matter ether. Since the latter, at present, is identified

as free energy of opposite polarity, this corresponds also to Einstein's theory (ref. 18).

Let us now assume that an electromagnetic radiation is capable of influencing the minute energy fields of the ether already described. It would be absorbed. The affected substance of the ether would, therefore, be changed into a dynamic state. As a result, the gravitational energy would be converted from repellant to attractive polarity. This would necessarily mean "condensation" to mass with gravity. Mass particles would be formed. Simultaneously, electrical charges, spin, and magnetic properties of the particles would be formed in this process. Internal resonnance in this dynamic mass formation from dynamic field energy would also be the result of quantum properties. In this way, one could imagine the formation of elementary particles.

At first, these ideas may sound far-fetched. However, they may make sufficient sense and are based on certain knowledge to give the engineer a clear picture of what mass is, and how its formation in the universe may be imagined.

36. Moreover, it may be useful to have an idea of the nature of the electromagnetic fields, which result in formation of mass.

Polarized light-waves are not concerned here, as V. Hlávatý has found by study of Einstein's unified-field theory. One can hardly be wrong when one extends this theory to all light waves, in view of what has been said in section 27. According to this, suitable radiation fields would possess waves which are short enough to effect the minute individual fields of which the ether consists. These waves would, therefore, be of the order of magnitude of the range of the nuclear binding fields.

37. Electromagnetic fields of such a "micro-gamma" radiation are not yet in the realm of possibilities. Gamma rays themselves go only as low as 10^{-11} cm. waves.

However, once we can produce waves of the order of 10^{-2} Fermi and below, we can also expect that gravity effects will appear which may perhaps be demonstrated.

38. It may be one of the most important problems of the future to produce extremely small and energy-rich waves of such magnitudes, and to control them. The problem of forming beams of such rays may perhaps be solved. Also an almost lossless energy obtained from mass would be in the realm of practical possibility. The yield expected would be much greater than that of the best nuclear processes which will be technically evaluated in the near future.

SUMMARY

Einstein's unified-field theory establishes that gravitational fields are connected with electro-magnetic fields. From more general field theories with six or more dimensions, we can expect the existence of an "intermediate field", which is neither gravitational nor electrical. Such an intermediate field could be identified as the non-electrical nuclear binding forces. This assumption leads to the concept of a primary-matter ether of free gravitational energy, which is not in contradiction with Michelson-Morley's experiment. Certain properties of this ether, as for example opposite polarity, are in agreement with cosmological concepts with regard to gravitation and expansion of space. This also gives a better understanding of the cause of the mass in motion and of inertia. Consequences of these concepts permit us to assume that electromagnetic fields of still unobtained waves will create possibilities which are technically of great benefit. They may be of importance for aviation and space flight as well as for almost lossless production of energy from mass radiation.

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